FORM PTO-1390 (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

# TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: VOI0200.US

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 09/889279

| INTERNATIONAL APPLICATION NO. | INTERNATIONAL FILING DATE | PRIORITY DATE CLAIMED |
|---|---|---|
| PCT/FI00/00990 | 14 November 2000 | 16 November 1999 |

TITLE OF INVENTION: CONSTRUCTION AND METHOD IN ELECTRIC MOTOR DRIVE

APPLICANT(S) FOR DO/EO/US: Viktor Soitu

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. [ ] The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is attached hereto (required only if not communicated by the International Bureau).
   b. [ ] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [ ] is attached hereto.
   b. [ ] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [ ] Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English lanugage translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

**Items 11 to 20 below concern document(s) or information included:**

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
14. [ ] A SECOND or SUBSEQUENT preliminary amendment.
15. [X] A substitute specification.
16. [ ] A change of power of attorney and/or address letter.
17. [ ] A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. [ ] A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. [ ] A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
0. [X] Other items or information:
    PCT/ISA/210 (English)
    PCT/RO/101 (English)

| U.S. APPLICATION NO (if known, see 37 CFR 1.5) | INTERNATIONAL APPLICATION NO | ATTORNEY'S DOCKET NUMBER |
|---|---|---|
| 09/889279 | PCT/FI00/00990 | VOI0200.US |

| 21. [X] The following fees are submitted: | CALCULATIONS PTO USE ONLY | |
|---|---|---|
| **BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):** | | |
| Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO ..... **$1000.00** | | |
| International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... **$860.00** | | |
| International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... **$710.00** | | |
| International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... **$690.00** | | |
| International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) ..... **$100.00** | | |
| **ENTER APPROPRIATE BASIC FEE AMOUNT =** | $ 860.00 | |
| Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)). | $ | |

| CLAIMS | NUMBER FILED | NUMBER EXTRA | RATE | | |
|---|---|---|---|---|---|
| Total claims | 19 - 20 = | | x **$18.00** | $ | |
| Independent claims | 2 - 3 = | | x **$80.00** | $ | |
| MULTIPLE DEPENDENT CLAIM(S) (if applicable) | | | + **$270.00** | $ | |
| **TOTAL OF ABOVE CALCULATIONS =** | | | | $ 860.00 | |
| [ ] Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. | | | | $ | |
| **SUBTOTAL =** | | | | $ 860.00 | |
| Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). | | | | $ | |
| **TOTAL NATIONAL FEE =** | | | | $ 860.00 | |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property + | | | | $ | |
| **TOTAL FEES ENCLOSED =** | | | | $ 860.00 | |
| | | | | **Amount to be refunded:** | $ |
| | | | | **charged:** | $ 860.00 |

a. [X] A check in the amount of $ 860.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 20-0095 . A duplicate copy of this sheet is enclosed.

d. [ ] Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO:

Todd T. Taylor
Taylor & Aust, P.C.
142 South Main Street
P.O. Box 560
Avilla, IN 46710

SIGNATURE

Todd T. Taylor
NAME

36,945
REGISTRATION NUMBER

PATENT

THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | | |
|---|---|---|
| In re Application of | ) | |
| Viktor Soitu | ) | Group: |
| Serial No.: | ) | |
| Filed: July 13, 2001 | ) | |
| Title: CONSTRUCTION AND METHOD IN ELECTRIC MOTOR DRIVE | ) | Examiner: |

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Concurrent with the filing of this application, Applicant hereby submits the following Amendment.

IN THE TITLE

Please delete the title and substitute the following therefor:

CONSTRUCTION AND METHOD OF AN ELECTRIC MOTOR DRIVE

IN THE SPECIFICATION

Please replace the original specification in its entirety with the attached substitute specification. Applicant submits that no new matter has been added hereby. A copy of the original specification with the handwritten changes indicated therein is also included herewith.

IN THE CLAIMS

Please cancel originally filed claims 1-16 and substitute the following new claims 17-35:

17. An electric motor drive, comprising:

a stator;

a non-rotary shaft carrying said stator;

a plurality of bearings connected to said non-rotary shaft;

a rotor rotatably positioned around said stator, said rotor being rotatably carried by said bearings; and

a machine actuator having a functional part with a short circuit arrangement associated with said rotor for operating said actuator.

18. The electric motor drive of claim 17, wherein said short circuit means is said rotor.

19. The electric motor drive of claim 17, further comprising a conveyor driving roll, wherein said functional part is said conveyor driving roll.

20. The electric motor drive of claim 17, further comprising:

a conveyor driving roll, said functional part being said conveyor driving roll;

a plurality of short circuiting bars; and

a plurality of rings, said short circuiting bars and said rings being arranged integral with said rotor;

wherein said short circuiting bars and said rings are said short circuit arrangement.

21. The electric motor drive of claim 17, wherein said non-rotary shaft is hollow and is configured for the flow in an axial direction therethrough of a cooling fluid including at least over-press air.

22. The electric motor drive of claim 17, further comprising hollow short circuit conductors configured for the flow therethrough of a cooling fluid including at least over-press air, said hollow short circuit conductors are said short circuit means.

23. The electric motor drive of claim 17, wherein said rotor is an electrically conductive compound metal structure including at least copper short circuit conductors which are attached to said rotor by one of explosive welding, butt welding into holes in said rotor and integral with the casting of said rotor.

24. The electric motor drive of claim 17, wherein said stator includes a winding, and further comprising star type couplings utilized in said winding of said stator, wherein said winding includes one of a three pole stator winding, a four pole stator winding and a six pole stator winding, wherein said motor has a power output from approximately 0.5 kilowatt to approximately 500.0 kilowatt, and wherein said motor has a rotational speed of approximately 0 rpm to approximately 20,000 rpm.

25. The electric motor drive of claim 17, further comprising:

a frequency transformer drive; and

an active rotation speed control.

26. The electric motor drive of claim 17, further comprising:

a stationary vacuum box; and

at least one supporting bracket being attached to said stationary vacuum box, said non-rotary shaft being attached to said at least one supporting bracket;

wherein said rotor is configured as a shell of a vacuum belt conveyor pulley.

27. The electric motor drive of claim 26, wherein said at least one supporting bracket is configured to have at least one connection surface configured to hold at least one of knife plates, rotary rippers and choppers.

28. The electric motor drive of claim 26, wherein said plurality of bearings include a first bearing and a second bearing, a distance D being defined as the distance therebetween, that the length of said vacuum belt conveyor pulley defines a length L; wherein D is larger than L.

29. The electric motor drive of claim 28, further comprising at least two flanges, one of said flanges connecting said first bearing to said rotor and an other flange connecting said second

bearing to said rotor, said first bearing and said second bearing being bushings which bridge the distance between length L and distance D.

30. The electric motor drive of claim 26, wherein each said at least one supporting bracket is formed double-folded similar to a "Z".

31. A method of constructing an electric motor drive comprising the steps of:

mounting a stator on a non-rotary shaft;

positioning a rotor around said stator;

connecting said rotor to said non-rotary shaft with bearings; and

incorporating a short circuit arrangement into said rotor;

wherein said rotor is configured as a functional part of a machine actuator.

32. The method of claim 31, wherein said short circuit arrangement is a plurality of rings and a plurality of short circuiting bars, said plurality of rings and said plurality of short circuiting bars arranged at least partially internal to said rotor;

33. The method of claim 31, further comprising the steps of:

cooling said electric motor drive with a cooling fluid including at least one of over-press air; and

directing said cooling fluid, said non-rotary shaft being hollow, said cooling fluid being so directed through at least one of said hollow non-rotary shaft and hollow short-circuit conductors.

34. The method of claim 31 further comprising the step of forming said rotor into an electrically conductive compound metal structure including at least copper short circuit conductors which are attached to said rotor by one of explosive welding, butt welding into holes in said rotor and integral with the casting of said rotor.

35. The method of claim 31, further comprising the steps of:

forming said rotor as a shell of a vacuum belt conveyor pulley;

providing a stationary vacuum box;

attaching at least one supporting bracket to said stationary vacuum box; and

attaching said non-rotary shaft to said at least one supporting bracket.

IN THE ABSTRACT

Please delete any previous abstract and substitute the attached new abstract.

REMARKS

Should any question concerning any of the foregoing arise, the Examiner is invited to telephone the undersigned at (219) 897-3400.

Respectfully submitted,

Todd T. Taylor
Registration No. 36,945

Attorney for Applicant

TTT/tj

TAYLOR & AUST, P.C.
142 S. Main Street
P.O. Box 560
Avilla, IN 46710
Telephone: 219-897-3400
Facsimile: 219-897-9300

Enc.: Return postcard

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to. Commissioner for Patents, Washington, DC 20231. on: July 13, 2001

Todd T. Taylor, Reg. No 36,945
Name of Registered Representative

Signature

July 13, 2001
Date

# CONSTRUCTION AND METHOD OF AN ELECTRIC MOTOR DRIVE

## BACKGROUND OF THE INVENTION

### 1. Field of the invention.

The present invention relates to an electric motor drive and a method for the construction of an electric motor drive, and, more particularly, to an asynchronous motor, which has a stator mounted on a non-rotatory.

### 2. Description of the related art.

Asynchronous, compact drum motors have been presented in publications EP 0 582 563, US 4,868,436 and FI 811414. The first mentioned solution in these publications is carried into effect by keeping separate and individual copper short-circuit bars in position by pressing them in place with collars mounted on the end flanges of a motor.

The disadvantage of this arrangement is the poor heat transmission from the short-circuit bars to the rotor shell. Further, U.S. patent 4,868,436 discloses a rotor structure built up of a so called active part (i.e. electric plate package) and at least two separate rotor shell parts (i.e. support flange) and onto it by means of a screw coupling connected rotor shell, which makes the arrangement unnecessarily complicated. In application publication EP 0 617 155 there is a much similar solution (of above mentioned U.S. patent), where a motor's rotor package, is constructed/laminated of electric plates, and is connected together with short-circuiting conductors to a drum roller by means of a screw/press coupling, which operates as a roll surface. This solution is disadvantageous especially in manufacturing.

Further, in Finnish patent application 811414 there is presented a drum motor, which is designed especially for elevator purposes. In this application a separate roller with cable grooves, a brake surface area, for elevator's lifting cables, and brakes are mounted on the upper

shell of the rotor. The motor cooling is provided by machining radial ventilation holes in the roller and stator and to blow cooling air into the holes with a separate blower.

Relative to the above-mentioned approaches it is common for the actuator's connection to the drum motor to require special mounting arrangements and/or extra parts for a separate drive roll to be assembled onto an electrical motor's rotor (EP 0 582 563), a firmly assembled flange arrangement on the motor's frame (US 4,868,436) or a shell to be assembled outside the drum motor (FI 811414 and EP 0617 155 A1). The motor constructions in the above-mentioned innovations provide for cooling circulation to be carried out by traditional means. Thus, it is not possible to reach higher outputs than with a standard drum motor.

What is needed in the art is an electric motor drive and a method of constructing an electric motor drive which will provide a higher output.

## SUMMARY OF THE INVENTION

The present invention provides an electric motor and a method for constructing an electric motor with a higher output. It is principally distinctive to the construction of the electric motor of this invention, that the functional part of the motor's construction, the actuator, such as a conveyor's driving roll, is arranged to operate by having a short-circuit arrangement as the rotor of the asynchronous motor. In other words, the actuator (e.g. driving roll) is formed so as to constitute the rotor of the asynchronous motor, with the actuator being the short-circuit arrangement.

The construction according to one embodiment of the invention is characterized by the functional part of the machine construction, the actuator, such as a conveyor's driving roll, being arranged to operate by having a short-circuit arrangement as the rotor of the asynchronous motor.

It should be noted that the arrangement of the actuator being the short-circuit arrangement is referring to many various embodiments. In the most simple embodiment, the

actuator is formed as a one-piece solid roll shell being free from short-circuit bars and rings and also being free from laminated elements.

In another embodiment (also being free from laminated elements) short-circuit bars and rings are provided. Each of the bars and the rings are located within the roll shell, preferably with a tight or positive fit being provided between each bar and the roll shell, whereby additional mounting elements (e.g. collars and/or screws) are not needed.

The most important advantages of the construction of this invention is the simplicity of its construction, manufacturing and usage, its efficiency and reliability of working, and the most integrated and compact machine configuration possible. This configuration allows higher output and higher torque from the asynchronous massive rotor and a significant improvement in its performance in other ways as well.

The simplicity of the construction of this invention is based on the fact that there is no need to use traditional short-circuiting conductors, since the short-circuit arrangement is established directly in the functional part of the machine construction of the actuator, such as a conveyor's driving roll. On the other hand the structure of this invention makes is possible to use traditional short-circuiting connectors in a new way, so that they are located internal to a functional part of the machine construction (actuator) as the rotor shell, such as a conveyor's driving roll. The asynchronous motor is equipped with primary and secondary cooling circulation to cool both the stator and the rotor. Cooling fluid is carried through the stator shaft and with the help of holes in the shaft as a parallel flow through the flow system in the rotor shell.

As a further improvement, the rotor is manufactured of an electrically conductive compound metal structure, where copper short-circuit bars or pipes and rings are explosion

welded into pre-drilled/machined holes/slots. On the other hand during manufacturing of the asynchronous motor it is also possible to utilize a casting technique.

A further embodiment of the present invention, is to assemble the stator on the hollow shaft/pipe which also serves as a stator shaft, that is used to feed over-pressure cooling air. This is effectuated by using a hermetic primary cooling method which is known from EP 0 617 155 and which prevents dirt from penetrating into the drum motor, which is not possible with the conventional, free breathing air-cooled solutions.

A further embodiment of the present invention, provides for short-circuit hollow bars or pipes to be positioned within the rotor shell, functioning as secondary cooling channels. Thereby making it possible to carry cooling air to the hottest spots of the rotor, which helps both to obtain the maximum output and to increase the amount of starts/stops the (actuator) equipped with the motor is capable of.

The method according to another embodiment of the present invention is characterized by the functional part of a machine construction, an actuator, such as a conveyor's driving roll, being arranged to operate by having a short-circuit arrangement as the rotor of the asynchronous motor.

Important advantages of the method of this invention are the simplicity of the operating principle, the simple constructions which makes it possible, the reliability of the device, the compact machine construction (actuator) which integrates an asynchronous motor to achieve high mechanical load capacity, vibration strength, and high starting and operation torque features. The simplicity of the method of this invention is based on the fact that there is no need to use a separate laminated rotor component with traditional short-circuiting conductors inside a functional part of the machine construction, rather a short-circuit arrangement is integrated directly into the functional part of the machine construction (actuator), such as a conveyor's

driving roll. The method of this invention makes it possible to utilize traditional short-circuiting connectors, located essentially internally on a functional part of the machine construction (actuator) as the rotor shell, such as a conveyor's driving roll.

An advantage of this innovation, makes it possible to increase an air gap diameter between a stator and a rotor once a maximum outer diameter and total length of a drum motor is limited. Thus by this innovative design it is possible to get higher output power and higher torque as compared to an asynchronous drum motor having the same main dimensions as this new innovative drum motor construction and having a standard laminated rotor component inside a rotor shell.

A further advantage of this method is the minimization of the manufacturing costs of the massive motor by manufacturing the rotor and the associated slots from cast steel.

A further advantage of this method is that the asynchronous motor is cooled effectively allowing a higher output than with conventional motors. This invention provides an hermetic seal and an axially directed cooling fluid flow through the asynchronous motor which makes possible the directing of cooling air to the hottest spots of the rotor, which in turn allows an increase in the maximum output and an increased number of starts/stops. In contrast to freely breathing air-cooled motors, the present invention prevents filth from penetrating into the drum motor structure.

Cooling of an asynchronous motor with a solid rotor can be realized either with or without a secondary cooling arrangement of hollow bars or tubes inside a functional part of the machine construction (actuator) such as the rotor shell. In constructions without a secondary cooling arrangement the cooling is taken care of only with a primary cooling arrangement such as an air flow arrangement through an air gap between an inner surface of a rotor shell and an outer surface of a stator component.

Furthermore, it is important that the short-circuit bars and rings are arranged essentially integral with rotor shell, at least partly or even totally, with internal arrangements. Such an arrangement provides for a much more efficient heat transfer between the steel shell and the copper short-circuit bars and rings than can be accomplished with traditional solutions. This also allows for higher output and an increase in the number of starts and stops of the asynchronous motor within a time interval.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of (an) embodiment(s) of the invention taken in conjunction with the accompanying drawing(s), wherein:

Fig. 1 is a longitudinal cross-section of a typical machine construction (actuator) unit, which is accomplished with the method in this invention;

Fig. 2 is a cross-sectional profile of a section along line "Fig. 2 – Fig. 2" in Fig. 1;

Figs. 3a-c present some alternative massive motor constructions of a drum motor;

Figs. 4 and 5 is a drum motor designed according to one embodiment of the present invention and integrated to one end of a vacuum belt conveyor construction, with Fig. 5 being a section along line V – V of Fig. 4.

Corresponding reference characters indicate corresponding parts throughout the several views. The exemplification(s) set out herein illustrate(s) one preferred embodiment of the invention, in one form, and such exemplification(s) (is)(are) not to be construed as limiting the scope of the invention in any manner.

## DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, and more particularly to Figs. 1-3, there is shown the construction of an electric motor drive. The electric motor drive being a so called solid asynchronous motor, which has stator 2 mounted on non-rotatory shaft 1 and around stator 2 is rotor 4, which is, by means of bearings 3, rotatably connected on shaft 1 and having a short-circuit arrangement is designed to drive a machine construction (actuator). The functional part of the machine construction (actuator), such as conveyor's 5 (Fig. 4) driving roll 5a, 5b or 5c, is designed to operate by an integrally connected short-circuit arrangement of rotor 4 of the asynchronous motor. Fig. 3c shows the most simple embodiment of the invention, in which conveyor's driving roll 5a is realized with a solid shell. Driving roll 5a operates directly as the short-circuit arrangement of rotor 4 without any traditional laminated rotor component having short-circuit conductors (e.g. short-circuit bars and rings). An alternate embodiment of this principle is shown in Fig. 3b, where driving roll 5b is designed to operate as the rotor of the asynchronous motor with the solid shell having on its inner surface drilled or machined holes or grooves 5d.

Different from Figs. 3b and 3c, the invention may be advantageously used in connection with the structure, where the short-circuit arrangement is realized in rotor's shell 4a with short-circuiting conductor bars 4b and rings 18. In this embodiment of the present invention short-circuiting connector bars 4b and rings 18 are arranged to operate at least partly internally of rotor's shell 4a operating as a functional part of the machine construction (actuator), such as conveyor's driving roll 5c. Examples of this embodiment as shown in Fig. 2, where round short-circuit bars 4b are used and in Fig. 3a where quadrangular short-circuit bars 4b' are used in rotor shell 4a'. Bars 4b as shown in Fig. 2 may be hollow, so that each bar includes a channel 4c for

piping cooling fluid. At each end, of shell 4a, a flange 7 is provided which connects the shell to one of the bearings 3.

Referring now to Fig. 3a there is shown yet another embodiment of the invention, where conveyor's driving roll 5a is realized by a solid shell having quadrangular short-circuit bars on its inner surface. This type of electrical motor design should be used when a compact drum motor constructions (e.g. maximum outer diameter and total length of the drum motor are limited) with high output power and torque are desired. Such a compact drum motor is needed in vacuum belt conveyors used for "tail threading" in paper machines.

A typical design of drum motor's stator component 2 consists typically a pile of 0.3 – 1.0 mm thick electrical sheets 21 which are mounted on stationary hollow shaft 1 and fixed at their position by spot welding stator end plates 20 to stationary hollow shaft 1. Stator windings 6 are connected via electrical connection cable 19 to an external electric grid.

Referring now to Figs. 4 and 5 there is shown one end of a vacuum belt conveyor including an endless air pervious belt 10 which travels across two rotary pulleys, only one pulley 4 being shown. The pulleys are supported by vacuum box 11. Therein a negative pressure is created by vacuum source (not shown). The negative pressure propagates through openings 12 of cover plate 13 and through belt 10 in order to convey a web of paper or similar material, in particular a lead strip or "tail" which has been separated from threading purposes (see e.g. U.S. patent 3,355,349).

In order to drive belt 10, pulley 4 is designed as the rotor of an electric motor drive according to the present invention. Similar to Fig. 1, stationary hollow shaft 1 supports stator 2 and (by means of bearings 3) rotor 4, which is pulley 4 of the vacuum belt conveyor and which comprises rotor shell 4a and two end-flanges 7.

Width W of conveyor 5 (and also length L) of the pulley's shell 4a should be relatively small, about 0.25 m. The pulley's 4a diameter should preferably be less than 0.15 m. The speed of belt 10 should be about the same as the operating speed of modern paper machines which may exceed 2000 m/min. Therefore, there is a need for very high motor output while the dimensions of the motor drive should be relatively small.

To fulfill these demands, distance D between the bearings 3 is larger than length L of pulley's shell 4a, in order to increase the internal space being available for stator 2 and for the short-circuit arrangement of rotor 4. As a consequence, each flange 7 is formed as a bushing which bridges the difference between length L and distance D. Furthermore, each of supporting brackets 8 which connect stationary shaft 1 to the side walls of vacuum box 11 is formed similar to a "z" (in other words: it is "double folded"). In addition, each support bracket 8 may be wrapped around the periphery of one of flanges 7.

In order to improve the cooling effect, hollow shaft 1 comprises at one of its ends an internal (e.g. coaxial) supply channel 15 as well as a discharge channel 16, as a result, cooling fluid X must pass the inner side of stator 2 as well as its outer side and the inner side of rotor 4 (plus the channels 4c, if existing, in bars 4b as shown in Fig. 1).

The above-mentioned supporting brackets 8 can also be used as a connection surface for vacuum belt conveyor's accessories (e.g. knife plates, rotary ripper and choppers) (which are not shown in the drawings).

In addition to the foregoing, the cooling of the machine construction (actuator) operating as rotor 4 of a asynchronous motor is realized mainly with primary cooling by carrying over-press cooling air X in an axial direction through stator shaft 1, which can be for example a hollow shaft, pipe or similar device and stator shaft 1 is equipped with a first flow arrangement 1a. It is possible to boost the cooling of the asynchronous motor beyond what is described above

or instead of it by way of secondary cooling which employs short-circuiting bars 4b' with flow arrangement 4c. Then, it is possible to carry cooling air X in an axial direction through hollow copper short-circuit bars 4b, according to the principle in Fig. 1 with the help of holes 1b in stator shaft 1 together with primary air flow 1a which take place together with the parallel flow to the hottest spots of rotor 4, which enables a higher output from the machine construction (actuator) and especially to allow more short run starts/stops.

Once an asynchronous motor has a solid rotor's cross section as shown in Figs. 3a, 3b and 3c, cooling is taken care of by an air flow arrangement through an air gap located between an inner surface of a rotor shell 5a, 5b, 5c and an outer surface of stator component 2.

Yet another embodiment of the present invention is to manufacture the rotor of electrically conductive compound metal structure, where copper short-circuit bars 4b; 4b' are integrally connected to steel rotor shell 4a; 4a' for example by explosion welding or by centrifugal casting.

It is possible with asynchronous motor, realized according to the invention, when using star type coupling for windings, to get the output of the drum motor equipped with three, four, or six pole stator windings which reach the 0.5 – 500 kW level and to have the speed of rotation typically in the area of 0 – 20000 rpm.

Yet still a further embodiment of the present invention (which is not shown in the drawings) there may be provided a frequency transformer for use by the asynchronous motor, which is equipped with active rotation speed control. In this embodiment rather traditional solutions can be used to achieve the desired effect.

And, in yet another embodiment of the present invention is a method with an electric motor drive, where the machine construction (actuator) uses an asynchronous motor, such as a drum motor, which has stator 2 mounted on non-rotatory shaft 1 and around stator 2 is rotor 4,

which is rotatable, having bearings 3, connected on shaft 1 and with a short-circuit arrangement. The functional part of the machine construction (actuator), such as a conveyor's 5 driving roll 5a, is arranged to operate by having a short-circuit arrangement as rotor 4 of the asynchronous motor (typical constructions shown in Figs. 2 and 3a). The method according to this principle is applied in the simplest way in constructions as shown in Fig. 3b, wherein driving roll's 5b machined grooves/slots 5d are arranged as the short-circuit arrangement. On the other hand in Fig. 3c is a similar type of solution without traditional short-circuit bars, wherein driving roll 5a is realized as a solid shell, which operates directly as the short-circuiting arrangement.

As a further embodiment of this method it is advantageous to benefit the machine construction with an asynchronous motor, whose short-circuit arrangement is connected to rotor 4, such as short circuiting bars 4b and rings 8 which are supported on rotor's shell 4a. In this connection short-circuit bars 4b and rings 8 are arranged to operate at least partly internally to shell 4a of rotors 4 of the operating functional part of the machine construction (actuator), such as conveyor's driving roll 5a. In this embodiment as presented, in Fig. 2, showing round short-circuit conductors 4b and further in Fig. 3a showing quadrangular short-circuit bars 4b'.

Furthermore, referring to Fig. 1 this method can be used with an asynchronous motor which is arranged to be cooled with a fluid flow. The cooling of the asynchronous motor is realized as a closed system by carrying a cooling fluid, such as over-press cooling air X, hermetically in an axial direction in primary flow arrangement 1a through stator shaft 1 such as a hollow shaft, pipe or similar device. The cooling of the asynchronous motor can be arranged in a manner other than that describe above by carrying a cooling fluid, such as over-press cooling air X hermetically in an axial direction in a secondary flow arrangement 4c provided in short-circuit conductors 4b such as hollow bars or pipes.

Referring to Fig. 1, rotor 4 of the solid asynchronous motor is manufactured of an electrically conductive compound metal structure, with copper short-circuit bars 4b which are welded, such as explosive welded or butt welded, into the holes in steel rotor shell 4a or that they are cast integral using a casting method, such as a press casting method. The above-mentioned methods utilize an assembly wherein every short-circuit bar 4b and ring 18 is integrated as an integral part of rotor shell 4a. This arrangement allows better heat transmission between the steel shell and copper short-circuit conductors. This fact is of great importance when trying to get higher maximum power from the machine constructions (actuators) than with traditional solutions and especially when short run starts/stops are numerous. The same is true with the embodiment shown in Fig. 3a comprising rotor shell 4a' and bar 4b'.

It is obvious that this invention is not limited to the above-mentioned or explained solutions, it can be considerably modified within its basic idea. Thereby it is possible to utilize the construction or arrangement of this invention in different manners, whereupon the dimensions and constructions can considerably differ from the hereby presented example drawings. Further, other types of fluids can be used in the cooling of the asynchronous motor realized according to the invention or the cooling can be done differently from what is presented above.

While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

## ABSTRACT

In an electric motor drive, a asynchronous motor, such as drum motor, has a stator (2) mounted on a non-rotatory shaft (1) and has rotatory, like by means of bearings (3), connected rotor (4), is arranged to drive the machine construction (actuator). The rotor (4) of the asynchronous motor conveyor's is arranged to be directly a functional part of the machine construction (actuator), like conveyor's (5) driving roll (5a). Also the rotor can be formed as a shell of pulley (4) which is part of a vacuum belt conveyor comprising a stationary vacuum box (11), the rotor drive further including a non-rotatory shaft (1) supported by at least one supporting bracket (8) which is connected to the vacuum box.

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# Construction and method in electric motor drive

The object of this invention is the construction in electric motor drive, where an asynchronous motor, such as drum motor or similar motor, which has a stator mounted on a non-rotatory shaft and around the stator is a rotor, which is rotatory, like by means of bearings, connected on the same shaft and has a short-circuit arrangement, is arranged to drive a machine construction (actuator).

Above described types of asynchronous, compact drum motors have been presented for example in publications EP 0 582 563,
US 4,868,436 and FI 811414. Among these, the first-mentioned solution is carried into effect by keeping separate and individual copper short-circuit bars in their position by pressing them in place with collars mounted on the end flanges of the motor.

The disadvantage of this type of solution is the poor heat transmission from the short-circuit bars to the rotor shell. Further in the solution of US-patent 4,868,436 the rotor structure is built up of so called active part i.e. electric plate package and at least two separate rotor shell parts i.e. support flange and onto it by means of screw coupling connected rotor shell, which makes the solution in question unnecessarily complicated. In application publication EP 0 617 155 there is a much similar solution (of above mentioned U.S.-patent), where motor's rotor package, which is constructed/laminated of electric plates, is

connected together with it's short-circuiting conductors to drum roller by means of screw/press coupling, which operates as a roll surface. Also this solution is disadvantageous especially in manufacturing. Further in latter Finnish patent application is presented a drum motor, which is designed especially for

elevator purposes. In this solution a separate roller with cable grooves and brake surface area for elevator's lifting cables and brakes is mounted on the upper shell of the rotor. E.g. in this solution is additionally proposed that the motor cooling is taken care of by machining radial ventilation holes in the roller and stator and to blow the cooling air to the holes with a separate blower.

To all of the above mentioned solutions it is common, that first of all respectively used machine construction (actuator)'s connection to the drum motor requires special mounting arrangements and/or extra parts for it i.e. a separate drive roll to be assembled on to an electrical motor's rotor (EP 0 582 563), a firmly assembled flange arrangement on the motor's frame (US 4,868,436) or a shell to be assembled outside the drum motor (FI 811414 and EP 0 617 155 A1). On the other hand in the motor constructions in the above mentioned innovations the cooling circulation is carried out by traditional means, thus it is not possible to reach higher outputs than with standard drum motor solutions.

The purpose of the construction of this invention is to overcome the above-described disadvantages and thereby essentially improve the level of the technique in this area. It is principally distinctive to the construction according to this invention, to carry out this purpose, that the functional part of the machine construction (actuator), like conveyor's driving roll or similar, is arranged to operate by having short-circuit arrangement as the rotor of the asynchronous motor. In other words: the "actuator" (e.g. driving roll) is formed to constitute itself the rotor of the asynchronous motor, with the actuator comprising the short-circuit arrangement.

The construction according to the invention is characterized by that the functional part of the machine construction (actuator), like conveyor's driving roll, is arranged to operate by having short-circuit arrangement as the rotor of the asynchronous motor.

It should be noted that the term "actuator comprising the short-circuit arrangement" is referring to many various (or different) embodiments. In the most simple embodiment, the actuator is formed as a one-piece solid roll shell being free from short-circuit bars and rings (also being free from laminated elements).

In another embodiment (also being free from laminated elements) short-circuit bars and rings are provided. Each of the bars and the rings will be located within the roll shell, preferably with a tight or positive fit

(or locking) being provided between each bar and the roll shell, whereby additional mounting elements (e.g. collars and/or screws) are no more needed.

The most important advantages of the construction of this invention is the simplicity of its construction, manufacturing and usage, efficiency and reliability of working, which attain the most possible integrated and compact machine configuration, which allow to get higher output and higher torque from the used asynchronous massive rotor and significantly to improve its performance in other ways too. The simplicity of the construction of this invention as advantageous solution is based e.g. on fact there is no need to use traditional short-circuiting conductors, as the short-circuit arrangement is established directly into the functional part of the machine construction (actuator), like conveyor's driving roll. On the other hand the structure of this invention makes it possible to use the traditional short-circuiting connectors in a new way, so that they are located essentially internally on a functional part of the machine construction (actuator) as the rotor shell, like conveyor's driving roll. When applying advantageously the structure of this invention, the asynchronous motor is equipped with primary and secondary cooling circulation to cool both the stator and the rotor for example so that the cooling fluid is firstly essentially carried through the stator shaft and with the help of the holes in the shaft elsewhere as parallel flow through the flow system in the rotor shell. As a further improvement the rotor is manufactured of electric conductive compound metal

structure, where copper short-circuit bars or pipes and rings are for example explosion welded into pre-drilled/machined holes/slots. On the other hand during manufacturing of the asynchronous motor it is possible to utilize also a casting technique.

Further advantageous solution is to assemble the stator on the hollow shaft/pipe also working as stator shaft, which is used for example to feed over-pressure cooling air. Herewith it is effectuated a hermetic primary cooling, which is known from EP 0 617 155 and which prevents dirt to penetrate into the drum motor, which is not possible to prevent with the conventional effectuated freely (open) breathing air-cooled solutions. Further advantageous feature is that the short-circuit hollow bars or pipes are positioned within the rotor shell, functioning as secondary cooling channels. Thereby it is possible to carry the cooling air to the hottest spots of the rotor, which helps in its way significantly both to obtain the maximum output and to increase the amount of starts/stops of the machine construction (actuator) equipped with the motor in question.

The advantageous solutions of the structure of the invention have been presented in separate independent patent claims.

Object of this invention is also a method for equivalent purpose, which is more specifically described in independent patent claim's introduction

section and whose characteristic features in corresponding patent claim's characteristic section.

The method according to the invention is characterized by that the functional part of the machine construction (actuator), like conveyor's driving roll, is arranged to operate by having short-circuit arrangement as the rotor of the asynchronous motor.

One of the most important advantages the method of this invention has, is the simplicity of the operating principle and the simple constructions which makes it possible and the reliability of working and which allows to gain the utmost compact machine construction (actuator) unit with integrally united asynchronous motor to achieve high mechanical load capacity, vibration strength and high starting and operation torque features. The simplicity of the method of this invention as a advantageous solution is based for example on the fact that there is no need to use a separate laminated rotor component with traditional short-circuiting conductors inside a functional part of the machine construction, by establishing a short-circuit arrangement directly into the functional part of the machine construction (actuator), like conveyor's driving roll. On the other hand the method of this invention makes it possible to use the traditional short-circuiting connectors in a new way, so that they are located essentially internally on a functional part of the machine
construction (actuator) as the rotor shell, like conveyor's driving roll.

Furthermore as an advantageous development of this innovation, it is possible to increase an air gap diameter between stator and rotor once a maximum outer diameter and total length of a drum motor is limited. Thus by this innovative design it is possible to get higher output power and higher torque compared to an asynchronous drum motor having same main dimensions as this new innovative drum motor construction and having a standard laminated rotor component inside a rotor shell.

Furthermore as an advantageous development of this method is to minimize the manufacturing costs of the here mentioned massive motor for example by manufacturing the rotor and the associated slots by casting them of steel.

Applying the method advantageously the asynchronous motor is being cooled effectively to get higher output than with conventional ones can be reached, because correctly carried out i.e. according to this invention realized for example hermetic and essentially in axial direction trough the asynchronous motor carried cooling fluid flow makes it possible for example to direct the over-press cooling air to the hottest spots of the rotor, which is an essential condition both to increase the maximum output and to increase the amount of starts/stops. On the other hand compared to the freely breathing air-cooled solutions this solution prevents especially in hard conditions filth to penetrate into the drum motor structure.

Cooling of asynchronous motor with a solid rotor can be realised either with or without a secondary cooling arrangement via hollow bars or tubes inside a functional part of the machine construction (actuator) as the rotor shell. In such constructions the cooling is taken care of only with a primary cooling arrangement (e.g. air flow arrangement though an air gap between an inner surface of rotor shell and an outer surface of stator component.

Furthermore it is important that the short-circuit bars and rings belonging advantageously to the short-circuiting adjustment are arranged essentially integral with rotor shell i.e. at least partly or then totally with internal arrangements, and thus also a much more efficient heat conduction than present, between the steel shell and the copper short-circuit bars and rings can accomplished than with the traditional solutions. This also gives better possibilities for higher output and to increase the starts and stops of the asynchronous motor within a certain time interval.

Advantageous solutions of the method of the invention have been presented in separate independent patent claims.

The invention is in more detail presented in the description and the attached drawings.

Figure 1 presents

a longitudinal cross section of a typical machine construction (actuator) unit, which is accomplished with the method in this invention and

Figure 2 presents
a cross-profile of spots Fig 2 - Fig. 2. in Figure 1.

Figures 3a - 3C present
some alternative massive motor constructions of a drum motor.

Figures 4 and 5 present
a drum motor designed according to the invention and integrated to one end of a vacuum belt conveyor construction, with Fig. 5 being a section along line V - V of Fig. 4.

Referring to Figures 1 to 3, the object of this invention is a construction in electric motor drive, where a so called solid asynchronous motor, which has a stator 2 mounted on a non-rotatory shaft 1 and around the stator is a rotor 4, which is, like by means of bearings 3, rotary connected on the same shaft 1 and has a short-circuit arrangement, is designed to drive a machine construction (actuator). The functional part of the machine construction (actuator), like conveyor's 5 driving roll 5a or 5b or 5c is designed to operate by integrally connected short-circuit arrangement as the rotor 4 of the asynchronous motor. Especially in Figure 3c is shown the most simple structure of the invention, in which conveyor's driving roll 5a is realized with a

solid shell, which operates directly as the short-circuit arrangement of the rotor 4 without any traditional laminated rotor component with short-circuit conductors (e.g. short-circuit bars and rings). The solution according to this principle is also shown in Figure 3b, where driving roll 5b is designed to operate as the rotor of the asynchronous motor with the solid shell having on its inner surface drilled or machined holes or grooves.

Different from Figures 3b and 3c, the invention may be advantageously used in connection with the structure, where the short-circuit arrangement can be realized in the rotor's shell 4a with short-circuiting conductor bars 4b and rings 8. In this connection short-circuiting connector bars 4b and rings 18 are arranged to operate at least partly internally of

the rotor's shell 4a operating as functional part of the machine construction (actuator), such as conveyor's driving roll 5c. This type of solutions are presented especially in Figure 2, where round short-circuit bars 4b are being used and in Figure 3a where quadrangular short-circuit bars 4b' are being used in rotor shell 4a'. The bars 4b shown in Figure 2 may be hollow, so that each bar comprises a channel 4c for piping cooling fluid. At each end of shell 4a, a flange 7 is provided which connects the shell to one of the bearings 3.

In Figure 3a is shown a design, where conveyor's driving roll 5a is realised by a solid shell having quadrangular short-circuit bars on its inner surface. This type of electrical motor design should be used

when a compact drum motor constructions (e.g. maximum outer diameter and total length of the drum motor are limited) with high output power and torque are desired. Such a compact drum motor is needed in vacuum belt conveyors used for "tail threading" in paper machines.

A typical design of drum motor's stator component 2 consists typically a pile of 0,3 - 1,0 mm thick electrical sheets 21 which are mounted on a stationary hollow shaft 1 and fixed at their position by spot welding stator end plates 20 to the stationary shaft. Stator windings 6 are connected via electrical connection cable 19 to an external electric grid.

Figures 4 and 5 show one end of a vacuum belt conveyor comprising an endless air pervious belt 10 which - in operation - travels across two rotary pulleys, only one pulley 4 being shown. The pulleys are supported by a vacuum box 11. Therein a negative pressure will be created by any vacuum source (not shown). The negative pressure will propagate through openings 12 of a cover plate 13 and through belt 10 in

order to convey a web of paper or similar material, in particular a lead strip or "tail" which has been separated from threading purposes (see e.g. US patent 3,355,349).

In order to drive the belt 10, a pulley 4 is designed as the rotor of an electric motor drive according to the present invention. Similar to Figure 1, a stationary hollow shaft 1 supports a stator 2 and (by means of bearings 3) the rotor 4, - which is the pulley

of the vacuum belt conveyor - and which again comprises a rotor shell 4a and two end-flanges 7.

Preferably, the following measures may be provided in order to adapt the electric motor drive to the demands of a vacuum belt conveyor:

The width W of conveyor 5 (and also the length L of the pulley's shell 4a should be relatively small, about 0,25 m. The pulley's diameter should preferably be less than 0,15 m. On the other hand, the speed of the belt should be about the same as the operating speed of modern paper machines which may exceed 2000 m/min. Therefore, there is a need for very high motor output while the dimensions of the motor drive should be relatively small.

To fulfil these demands, the distance D between the bearings 3 is larger than the length L of the pulley's shell 4a, in order to increase the internal space being available for stator 2 and for the short-circuit arrangement of the rotor 4. As a consequence, each flange 7 is formed as a bushing which bridges the difference between length L and distance D. Furthermore, each of the supporting brackets 8 which connect the stationary shaft 1 to the side walls of the vacuum box 11 is formed similar to a Z (in other words: it is "double

folded"). In addition, each support bracket 8 may be wrapped around the periphery of one of the flanges 7.

In order to improve the cooling effect, the hollow shaft 1 comprises at one of its ends an internal (e.g. coaxial) supply channel (15) as well as a discharge channel 16, as a result, all the cooling fluid X must pass the inner side of stator 2 as well as its outer side and the inner side of the rotor (plus the channels 4c, if existing, in the bars 4b in Figure 1).

Also, the following is advantageous: The above mentioned supporting brackets 8 can be used also as a connection surface for vacuum belt conveyor's accessories (e.g. knife plates, rotary rippers and choppers) (which is not shown as practical solution in enclosed drawings).

In addition to the things mentioned above, the cooling of the machine construction (actuator) operating as a rotor of a asynchronous motor is realized advantageously mainly with primary cooling by carrying over-press cooling air X in axial direction through the stator shaft 1, which can be for example a hollow shaft, pipe or similar and it is equipped with it's first flow arrangement 1a. On the other hand when using advantageously the structure of this invention it is possible to boost the cooling of the asynchronous motor besides what was described earlier or instead of it also with secondary cooling by equipping the short-circuiting bars 4b' with another flow arrangement 4c. Then, for example, it is possible to carry cooling air X in axial direction through the hollow copper short-circuit bars 4b, for example, according to the principle in Figure 1 with the help of the holes 1b in the stator shaft 1 together with the primary air flow

1a which take place together with the parallel flow to the hottest
sports of the rotor, which helps to get higher output from the machine construction (actuator) and especially to improve to carry the short run starts/stops.

Once an asynchronous motor has a solid rotor's cross section as shown in Figures 3a, 3b and 3c, cooling is taken care of an air flow arrangement through an air gap which locates between an inner surface of a rotor shell 5a, 5b, 5c and an outer surface of stator component 2.

Further advantageous solution of the structure of the invention is to manufacture the rotor of electric conductive compound metal structure, where copper short-circuit bars 4b; 4b' are integrally connected to the steel rotor shell 4a; 4a' for example by explosion welding or by centrifugal casting.

It is possible with the asynchronous motor realized according to the invention when using especially star type coupling for windings, to get the output of the drum motor equipped with three, four, or six pole stator windings always reach the level 0,5 - 500 kW and to have the speed of rotation typically in the area of 0 - 20000 rpm.

As a further advantageous development (which is not shown in enclosed drawings) it is advantageous to benefit the frequency transformer used by the asynchronous motor, which is equipped with active rotation speed control. In this connection rather

traditional solutions can be used to achieve the wanted effect.

The object of this invention is also a method with an electric motor drive, where the machine construction (actuator) is used by a asynchronous motor, such as drum motor, which has a stator 2 mounted on a non-rotatory shaft 1 and around the stator is a rotor 4, which is rotatory, like by means of bearings 3, connected on the same shaft 1 and has a short-circuit arrangement. The functional part of the machine construction (actuator), like conveyor's 5 driving roll 5a, is arranged to operate by having short-circuit arrangement as the rotor 4 of the asynchronous motor (typical constructions shown in Figures 2 and 3a). The method according to this principle is applied in simplest way for example in constructions in Figure 3b, wherein driving roll's 5b machined grooves/slots 5d are arranged as the short-circuit arrangement. On the other hand in Figure 3c is a similar type of solution without traditional short-circuit bars, wherein the driving roll 5a is realized a solid shell, which operates directly as the short-circuiting arrangement.

Furthermore as an advantageous application of this method it is advantageous to benefit it with asynchronous motor, whose short-circuit arrangement is connected to the rotor 4, like short circuiting bars 4b and rings 8 are supported on rotor's shell 4a. In this connection short-circuit bars and rings belonging to the short-circuit arrangement are arranged to operate at least partly internally as the rotor's 4 shell 4a of the operating functional part of the machine

construction (actuator), such as conveyor's driving roll 5a. In this connection this type of solution is presented, especially in Figure 2, showing round short-circuit conductors 4b and further in Figure 3a showing quadrangular short-circuit bars 4b'.

Furthermore referring to Figure 1 this method can be used with an asynchronous motor which is arranged to be cooled by having a fluid flow. The cooling of the asynchronous motor is realized as a closed system by carrying cooling fluid, such as over-press cooling air X, hermetically essentially in axial direction in a primary flow arrangement 1a through the stator shaft 1 like hollow shaft, pipe or similar. On the other hand the cooling of the asynchronous motor can be arranged instead of as described above by carrying cooling fluid, such as over-press cooling air X hermetically essentially in axial direction in a secondary flow arrangement 4c provided in short-circuit conductors 4b like hollow bars or pipes.

Especially referring to Figure 1, as an example: Rotor 4 of the solid asynchronous motor is manufactured of electric conductive compound metal structure, when advantageously, for example, copper short circuit bars 4b which are welded, like explosive welded or butt welded into the holes in the steel rotor shell 4a or that they are cast integral with a most suitable casting method, like press casting method (solution is not presented in Figure 1). With above mentioned methods every short-circuit bar 4b and ring 18 is integrated as an integral part of rotor shell 4a, which allows to achieve better heat transmission between the

steel shell and copper short-circuit conductors. This fact has a great importance when trying to get higher maximum power from the machine constructions (actuators) than with traditional solutions and especially when short run starts/stops are in question. The same is true with the embodiment shown in Figure 3a comprising rotor shell 4a' and bar 4b'.

It is obvious that this invention is not limited to the above mentioned or explained solutions, it can be considerably modified within it's basic idea. Thereby it is possible firstly to utilize the construction or arrangement of this invention in most different connections, whereupon the dimensions and constructions can considerably differ from the hereby presented example drawings. On the other hand other type of fluids can be used in the cooling of the asynchronous motor realized according to the invention or the cooling can be done differently from what presented above.

Claims

1. A construction in electric motor drive, where an asynchronous motor, such as drum motor, which has a stator (2) mounted on a non-rotatory shaft (1), and around the stator is a rotor (4), which is rotatory, like by means of bearings (3), connected on the same shaft (1) and has a short-circuit arrangement, is designed to drive a machine construction (actuator), **characterized in** that the functional part of the machine construction (actuator), like conveyor's (5) driving roll (5a, 5b, 5c), is arranged to operate by having short-circuit arrangement as the rotor (4) of the asynchronous motor.

2. The structure as claimed in claim 1, wherein the short-circuit arrangement is established by the short circuiting bars (4b, 4b') and rings (18) supported on the rotor's shell (4a,4a'), **characterized in** that the short-circuiting bars (4b, 4b') and rings (18) belonging to the short-circuit arrangement are arranged integral with the rotor's (4) shell (4a, 4a'), which is a functional part of the machine construction (actuator), like conveyor's driving roll (5).

3. The structure as claimed in claim 1 or claim 2, wherein an asynchronous motor is arranged to be cooled by having a fluid flow, **characterized** in that the cooling of the asynchronous motor is realized in a closed system, by carrying cooling

fluid, such as over-press cooling air (x) hermetically essentially in axial direction with it's primary flow arrangement (1a) through the stator shaft (1) like hollow shaft or pipe and/or with secondary flow arrangement (4c) through short-circuit conductors (4b ) like hollow bars or pipes.

4. The structure as claimed in any of the claims 1-3, **characterized in** that the rotor (4) of the solid asynchronous motor comprises an of electric conductive compound metal manufactured structure, preferably comprising copper short circuit conductors (4b, 4b'), which are welded by explosive welding, butt welding into the holes in the steel rotor shell (4a, 4a') or that they are cast integral with the rotor shell in their places by a suitable casting method (e.g. centrifugal casting method).

5. The structure as claimed in any of the claims 1-4, **characterized in** that that when using especially star type coupling for windings, the output of the asynchronous motor equipped with three, four, or six pole stator windings is 0,5 - 500 kW having speed of rotation 0-20 000 rpm.

6. The structure as claimed in some of the claims 1-5, **characterized in** that the asynchronous motor is having a frequency transformer drive, which is equipped with an active rotation speed control.

7. The structure as claimed in some of the claims 1-6, **characterized in** that the rotor is

formed as a shell of a pulley (4) which is part of a vacuum belt conveyor (5) comprising a stationary vacuum box (11), the rotor drive further comprising: said central shaft (1) being supported by at least one supporting bracket (8) which is connected to the vacuum box (11).

8. The structure as claimed in some of the claims 1-7, **characterized in** that the drum motor's supporting brackets (8) can be used also as a connection surface(s) of the vacuum belt conveyor's accessories (e.g. knife plates, rotary rippers and choppers).

9. The structure as claimed in claim 7, **characterized in** that the distance D between the bearings (3) supporting the pulley (4) is larger than the length L of the pulley's shell (4a).

10. The structure as claimed in claim 9, wherein each flange (7) which connects an end of shell (4a, 4a') to one of the bearings (3) is formed as a bushing which bridges the distance between length L and D.

11. The structure as claimed in claim 9, wherein each supporting bracket (8) - seen in a longitudinal section of the conveyor (5), in Figure 5 - is formed double-folded similar to a Z.

12. Method for electric motor drive, where a machine construction (actuator) used by an asynchronous motor, such as drum motor, which has a

stator (2) mounted on a non-rotatory shaft (1) and around the stator is a rotor (4), which is rotatory, like by means of bearings (3), connected on the same shaft (1) and has a short-circuit arrangement, **characterized in** that the functional part of the machine construction (actuator), like conveyor's (5) driving roll (5a), operates by having short-circuit arrangement as the rotor (4) of the asynchronous motor.

13. Method as claimed in claim 12 with asynchronous motor, where the short-circuit arrangement is realized in connection with the rotor (4) like having short-circuit conductor bars (4b, 4b') and rings (18) supported on the rotor's shell (4a), **characterized in** that to the short-circuit arrangement operate at least partly internally as the rotor's (4) shell (4a, 4a') of the operating functional part of the machine construction (actuator), such as conveyor's driving roll (5a, 5b, 5c).

14. Method as claimed in claim 12 or 13 wherein a asynchronous motor is cooled by having a fluid flow, **characterized in** that the cooling of the asynchronous motor is realized as closed by carrying cooling fluid, such as over-press cooling air (x) hermetically essentially in axial direction with it's primary flow arrangement (1a) through the stator shaft (1) like hollow shaft or pipe and/or through with secondary flow arrangement (4c) equipped short-circuit conductors (4b') like hollow bars or pipes.

15. Method as claimed in some of the claims 12-14, **characterized in** that the rotor (4) of the solid asynchronous motor is manufacture of electric conductive compound metal structure, whenupon most suitable are copper short circuit conductors (4b, 4b'), which are connected into the holes and/or grooves by welding, like explosive welding or butt welding in the steel rotor shell (4a, 4a') or that they are cast integral within the rotor by a suitable casting method, like centrifugal casting method.

16. Method as claimed in some of the claims 12-15, **characterized in** that the rotor is formed as a shell of a pulley (4) which is part of a vacuum belt conveyor (5) comprising a stationary vacuum box (11), the rotor drive further comprising: said central shaft (1) being supported by at least one supporting bracket (8) which is connected to the vacuum box (11).

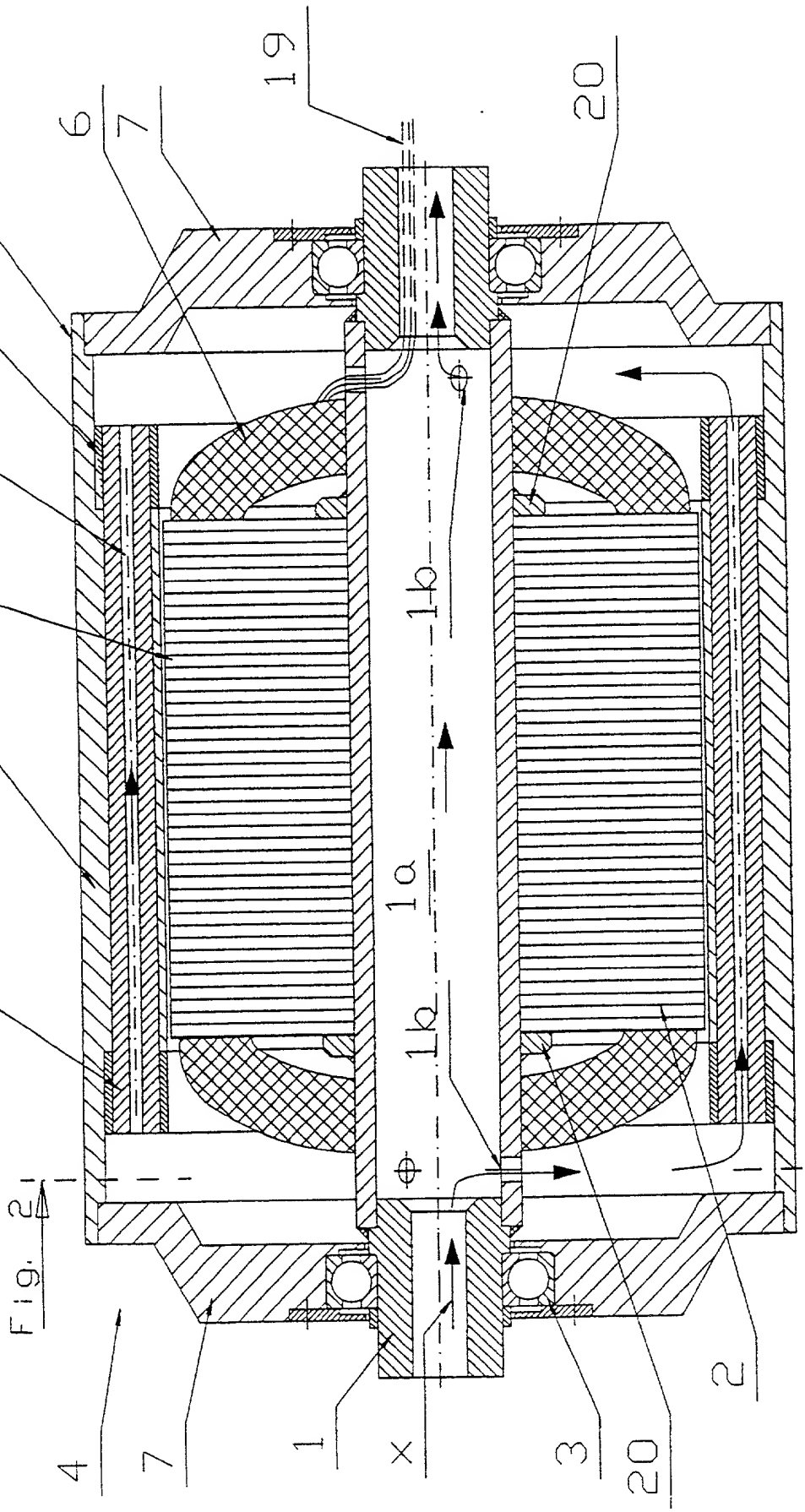


Fig. 1

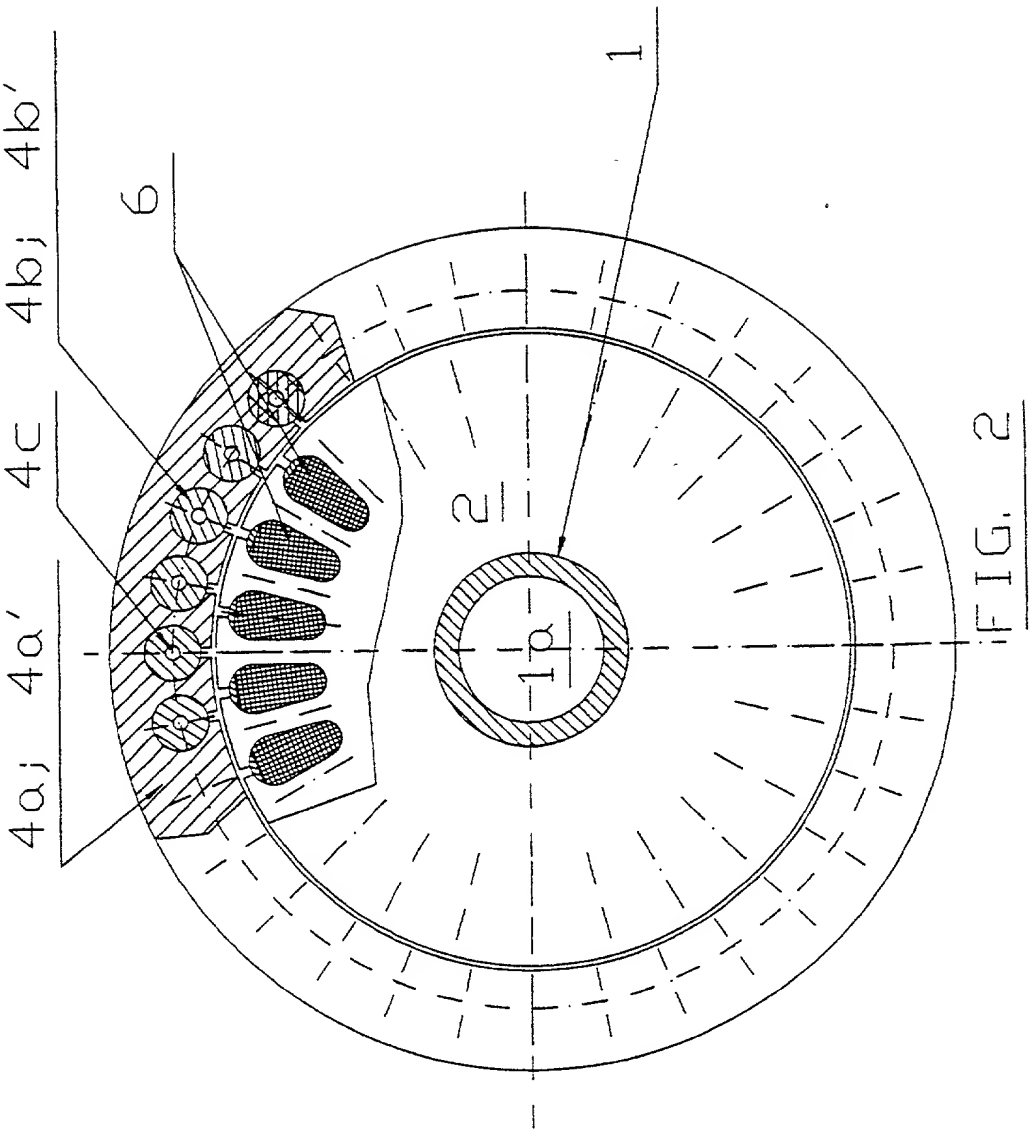


FIG. 2

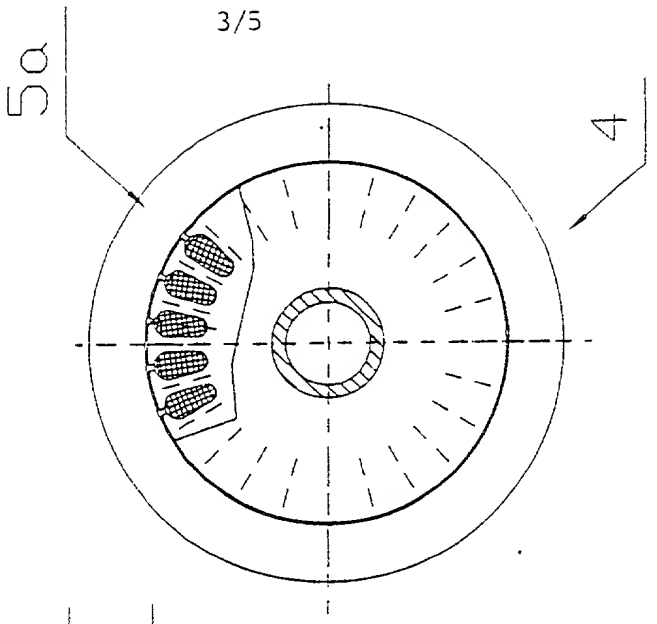


Fig. 3c

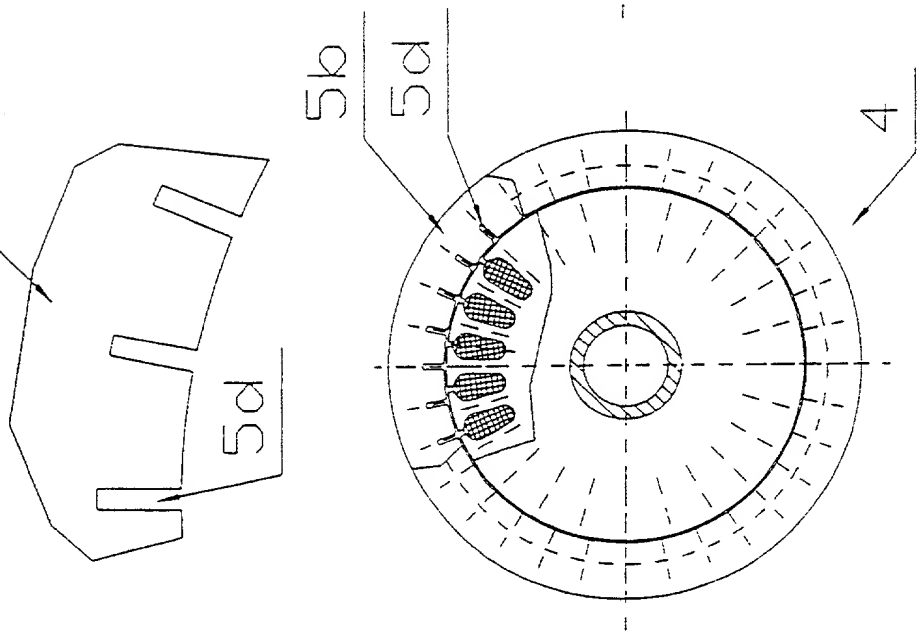


Fig. 3b

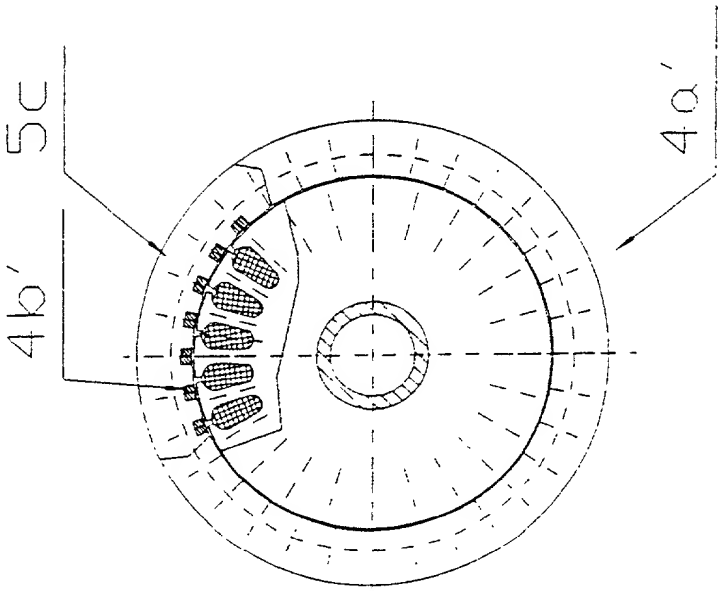


Fig. 3a

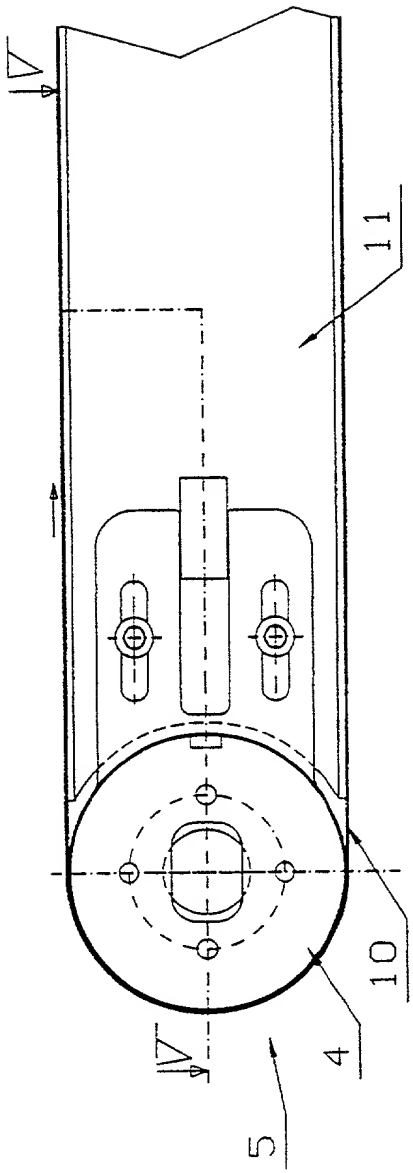


FIG. 4

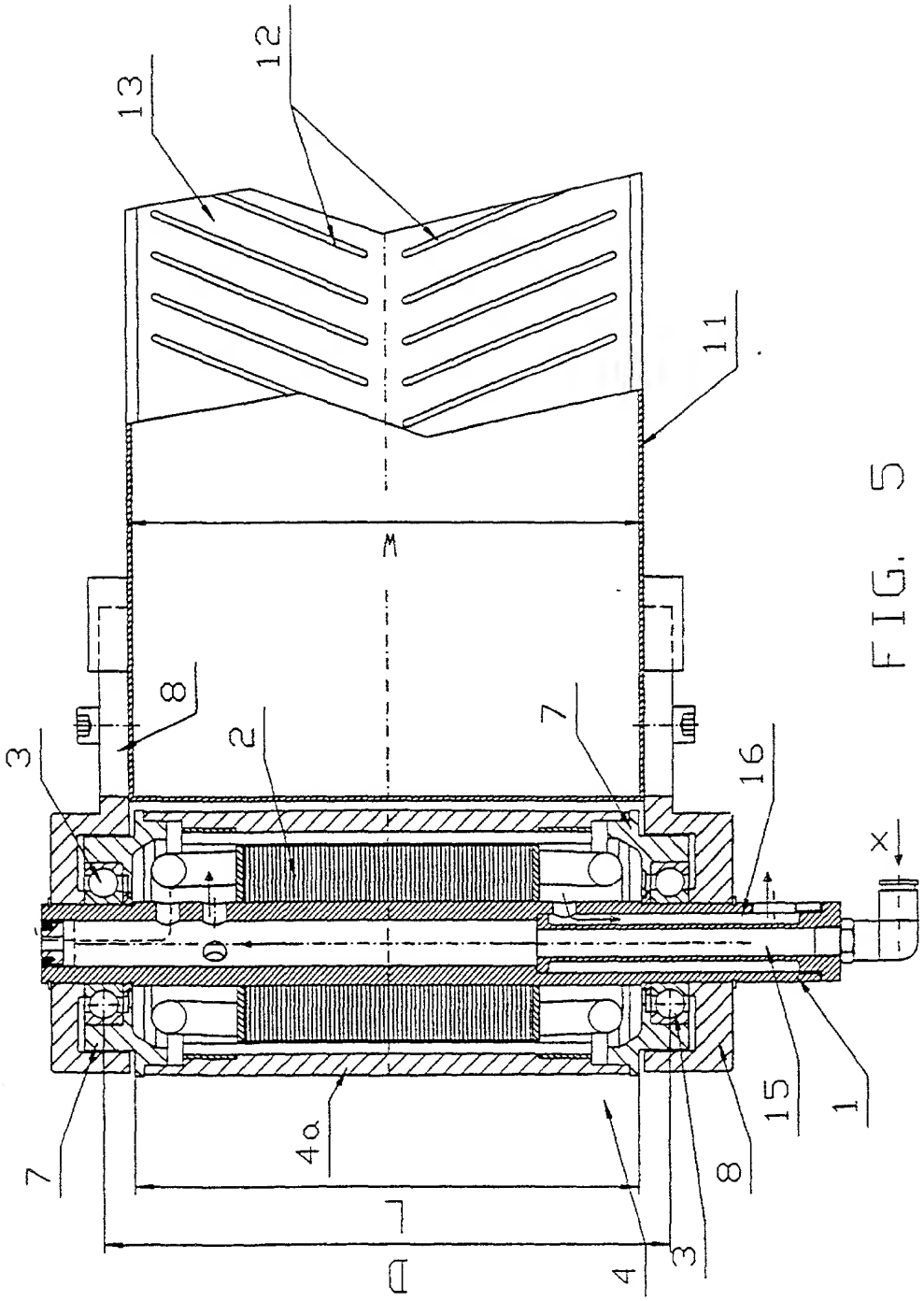


FIG. 5

ATTORNEY'S DOCKET NO. VOI0200.US

PCT/USA NATIONAL DECLARATION AND POWER OF ATTORNEY
FOR U.S. PATENT APPLICATIONS
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER 35 U.S.C SECTION 371(c)(4)

As a below named inventor, I hereby declare that

My residence, post office address and citizenship are as stated below next to my name:

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the invention described and claimed in international application No. PCT/FI00/00990 entitled: CONSTRUCTION AND METHOD OF AN ELECTRIC MOTOR DRIVE, and as amended on _____ (if any), which I have reviewed, and I understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above and for which I solicit a patent; that I do not know and do not believe that this invention was ever known or used in the United States of America before my or our invention or discovery thereof, or patented or described in any printed publication in any country before my or our invention or discovery thereof, or more than one year prior to my international application; that this invention was not in public use or on sale in the United States of America for more than one year prior to my international application; that this invention has not been patented or made the subject of an inventor's certificate issued before the date of my international application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months before my international application; that I acknowledge my duty to disclose information of which I am aware which is material to the examination of this application; and that prior to filing said international application, applications for patent or inventor's certificate on this invention or discovery which have been filed by me or my legal representatives or assigns in any country foreign to the United States of America are as follows.

(a) none filed more than 12 months prior to said international application, unless named below:

(b) earliest filed less than 12 months prior to said international application (the priority of which is hereby claimed under 35 U.S.C. Section 365):

FI 19992456, filed November 16, 1999.

I hereby claim the benefit under Title 35, United States Code, §120, of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a), which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

| (Application Serial No.) | (Filing Date) | (Status)(patented, pending, abandoned) |
|---|---|---|

I hereby appoint Todd T. Taylor, Reg. No. 36,945; Ronald K. Aust, Reg. No. 36,735; Keith J. Swedo, Reg. No. 43,176, Max W. Garwood, Reg. No. 47,589 and Jeffrey T. Knapp, Reg. No. 45,384, of the firm of TAYLOR & AUST, P.C., as attorney(s)/patent agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

SEND CORRESPONDENCE TO:
Todd T. Taylor
TAYLOR & AUST, P.C.
142 S. Main Street
P.O. Box 560
Avilla, IN 46710

DIRECT TELEPHONE CALLS TO:
Todd T. Taylor
Telephone: 219-897-3400
FAX: 219-897-9300

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: Viktor Soini

Residence: FIN-53810 Lappeenranta, Finland FIN Citizenship: RU

Post Office Address: Kourulanraitti 3 A 12, FIN-53810 Lappeenranta, Finland

Inventor's Signature: X V. Soini Date: X 02.07.2001